$$A_{0,i_1}^{k} \leftarrow A_{i_1,i_1}^{k} \leftarrow A_{i_1,i_2}^{k} \leftarrow \cdots \leftarrow A_{i_{m-1},i_{m-1}}^{k} \leftarrow A_{i_{m-1},G}^{k} \tag{11}$$

In equation (11), ←shows a nonexistent path, that is, there is no path from A^k_{0,i_1} to $A^k_{i_1,i_1}$.

Operation of Data Transmission Portion 146

The data transmission portion **146** produces along with time the operating data to be given to the drive portions **120***a* to **120***d* for realizing the operation of the robot **1** shown by the operational arcs included in the operational path determined by the arc selection portion **144** and supplies it to the drive portions **120***a* to **120***d*.

As shown in the explanation of the operation of the arc selection portion **144**, the series of operational arcs A^k_{ij} from the starting state S_s of the robot **1** to the target state S_G is output.

The data transmission portion **146** selects the operational arc A^k_{GG} from the target state S_G to the target state S_G by the same procedure an the selection of the operational arc by the arc selection portion **144** and adds it to the end of the series of the operational arc (11).

Accordingly, finally, the following series of operational arcs is produced by the data transmission portion **146**:

$$A_{k0i_1} \leftarrow A^k_{i_1,i_1} \leftarrow A^k_{i_1,i_2} \leftarrow A^k_{i_2,i_2} \leftarrow \cdots \leftarrow A^k_{i_{m-1},i_{m-1}} \leftarrow A^k_{i_{m-1},G} \leftarrow A^k_{G,G} \tag{12}$$

FIG. **8** is a status transition chart giving weighting coefficients to the status transition chart shown in FIG. **4**, specifying the state **3** as the starting state, and specifying the state **4** as the target state.

FIG. **9** is a view of the operational arcs determtned by the status transition preparation portion **140**, path selection portion **142**, arc selection portion **144**, and data transmission portion **146** based on the status transition chart shown in FIG. **8**.

As shown in FIG. **8** and FIG. **9**, the data transmission portion **146** produces the time-based operating data to be given to the drive portions **120***a* to **120***d* to cause the robot to perform the operation indicated by the operational arcs and supplies them to the drive portions **120***a* to **120***d*.

However, when the starting state S_s and the target state S_G match, the series of operational arcs A^k_{GG} is produced. At this time, the operating data corresponding to the series of operational arcs A^k_{GG} is not supplied to the drive portions **120***a* to **120***d*. In this case, the state is not particularly changed and therefore useless processing can be eliminated.

Below, the operation of the robot **1** will be explained.

The status transition preparation portion **140** of the control portion **12** detects the state of passage of the robot **1** from the starting state to the target state, prepares a status transition list based on the detected state, the operational arcs when passing between states, and the status transition chart shown in FIG. **4**, and gives to each of the operational arcs a weighting coefficient corresponding to the probable weight P^k shown in equation 1.

The path selection portion **142** selects a group of the operational arcs giving the smallest sum of weighting coefficients of the operational arcs included in the operational path in accordance with the routine shown in equation 2 to equation 9 and FIG. **6** as the operational path which the robot **1** passes from the starting state to the target state.

The arc selection portion **144** selects based on probability one of the operational arcs included in the operational path selected by the path selection portion **142** in accordance with the routine shown in equation 10 and equation 11 based on the weighting coefficients given to the operational arcs and decides on the final operational path.

The data transmission portion **146** produces the operating data along with time to be given to the drive portions **120***a* to **120***d* to realize the operation of the robot shown by the operational arcs included in the operational path decided on by the arc selection portion **144** and supplies it to the drive portions **120***a* to **120***d*.

The drive portions **120***a* to **120***d* drive the legs **10***a* to **10***d* in accordance with the operating data supplied from the data transmission portion **146** to realize the operation of each state from the starting state to the target state and the operations of the robot **1** shown by the operational arcs included in the final operational path.

As explained above, according to the apparatus for the control of the actions of robots of the present invention, the robot **1** can be given a plurality of patterns of action based on the operations of the robot **1** in each predefined state and the operations of the robot **1** in transition between states where one or more defined operational arcs are shown.

Further, even if the robot **1** is operated several times from the starting state to the target state in the same way, each time it operates from a new starting state to the target state, an operational path including a different operational arc is finally determined by the arc selection portion **144**, so the operations of the robot become diversified and the expressability becomes enhanced.

Note that in the above explanation, reference was made to the case of determination of the operational path based on the states, operational arcs, and weighting coefficients prefixed by the control portion **12** for the robot **1**, but for example the selectable operational arcs may be limited based on sensor data input from the sensor **16** or dynamic changes may be made to the values of the weighting coefficients or other steps taken so as to change the pattern of action of the robot **1** in accordance with its surrounding environment.

Further, the contents of the operations in the program of the control portion **12** were illustrations. It is also possible to realize the robot control method of the present invention using just the necessary portions extracted in accordance with the application of the robot **1**.

As explained above, according to the methods and apparatus for control of a robot of the present invention, it is possible to make the operations of a robot more diversified.

Further, according to the methods and apparatus for control of a robot of the present invention, it is possible to increase the number of matter expressable by the operations of the robot.

Further, according to the methods of control of a robot of the present invention, it is possible to enhance the expressability of the operations of a robot.

What is claimed is:

1. A robot control method for controlling the operation of a robot so as to pass through a plurality of states corresponding to a predetermined operation, comprising:

determining at least one operational arc between two directly passable states among the plurality of states showing the operation of said robot when passing between the two states,

giving to each of the determined operational arcs a weighting coefficient corresponding to the probability of that operational arc being selected,

selecting on a probable basis one of said operational arcs between said two states when making the operation of the robot pass between said two states based on said weighting coefficients of the operational arcs between said two states, and

controlling the robot so as to perform the operation shown by the selected operational arc when making the operation of the robot pass between said two states; and

controlling the robot so as to return to a first of said two states, wherein said operational arc includes a self operational arc showing the operation of said robot when returning to the first state.

2. A robot control method as set forth in claim 1, when making the operation of the robot pass between two or more states among the plurality of states, operational arcs are selected between each two directly passable states among said two or more states so that the sum of the weighting coefficients becomes smallest.

3. A robot control method as set forth in claim 1, wherein said operational arc includes a self operational arc showing the operation of said robot when returning from one state among the plurality of states to the same one state.

4. A robot control apparatus for controlling the operation of a robot having a plurality of states corresponding to a predetermined operation,

at least one operational arc being determined between each of any two directly passable states among said plurality of states showing the operation of the robot when passing between said two states, comprising

a weighting means for giving to each of the determined arcs of operation a weighting coefficient corresponding to the probability of that operational arc being selected,

an operational arc selecting means for selecting based on probability one of said operational arcs between said two states when making the operation of the robot pass between said two states based on said weighting coefficients of the operational arcs between said two states,

an operating data producing means for producing along with time operating data corresponding to the operation of said robot shown by said selected operational arc, and

controlling means for controlling the operation of the robot based on said produced operating data, wherein

said operating data producing means suppresses the production of said operating data corresponding to said self operational arc before said transition in state and after said transition in state when the states of the robot before the transition of state and after the transition of state coincide.

5. A robot control apparatus as set forth in claim 4, wherein

said operational arc includes a self operational arc showing the operation of said robot when returning from one state among the plurality of states to said same one state.

* * * * *